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STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005

EXAMINER

HUISMAN, DAVID J

ART UNIT PAPER NUMBER

2183

DATE MAILED: 11/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/855,776

Applicant(s)

KUMAMOTO ET AL.

Examiner

David J. Huisman

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 August 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 May 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. Claims 1-29 have been examined.

Papers Submitted

2. It is hereby acknowledged that the following papers have been received and placed of record in the file: Amendment as received on 8/25/2005.

Claim Objections

3. Claim 1 is objected to because of the following informalities: In line 8, replace "instruction" with --instructions--. Appropriate correction is required.
4. Claim 17 is objected to because of the following informalities: Please replace the period at the end of the 2nd to last paragraph with more appropriate punctuation. Appropriate correction is required.
5. Claim 22 is objected to because of the following informalities: In line 10, the phrase "wherein some of said instruction control units each comprising an..." is not proper grammar. In addition, in line 15, the phrase "both from said single instruction memory" is had to understand when read with the rest of the claim as a whole. The examiner believes that applicant is trying to claim that both the first and second series are from the single instruction memory, but this should be made more clear. Appropriate correction is required.
6. Claim 27 is objected to because of the following informalities: Please replace "having" with --have-- (or an equivalent) in line 9. Appropriate correction is required.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 24-26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

9. Claims 24-26 recite the limitation "the single series of instructions" in the last paragraph. There is insufficient antecedent basis for this limitation in the claim. It will be interpreted as just instructions.

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

11. Claims 17 and 25 are rejected under 35 U.S.C. 102(e) as being anticipated by Fernando et al., U.S. Patent No. 6,272,616 (as applied in the previous Office Action and herein referred to as Fernando).

12. Referring to claim 17, Fernando has taught a processor control apparatus comprising:

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- a) a single instruction memory for storing a plurality of series of instructions to be executed by a plurality of arithmetic units. See Fig. 1, components 12 and 26. Fig. 7 shows multiple series of instructions being executed by different units.
- b) an instruction decoder for decoding a series of instructions from said instruction memory, and outputting a decoded result to any of said plurality of arithmetic units. See Fig. 1, component 22a and 22b.
- c) a selector selectively switching between a plurality of series of instructions from said instruction memory to be decoded by said instruction decoder, and supplying a series of instructions thus selected to said instruction decoder. See Fig. 1, component 21, and claim 44 of Fernando.
- d) wherein said instruction memory has a plurality of ports for issuing said series of instructions to said instruction decoder. See Fig. 1 component 12 and note that multiple ports are connected to multiple fetch units and ultimately to multiple decoders.
- e) wherein said plurality of series of instructions are issued to said plurality of arithmetic units from the instruction memory to be simultaneously and independently driven both upon the instructions including different commands for each of the plurality of instruction control units and including a same command for each of the plurality of instruction control units. Looking at Fig. 1, it can be seen that when multiplexer 21 selects instructions from fetcher 20a, then the units 26 in components 24a and 24b will be simultaneously driven (by a first instruction stream). This is shown more specifically in Fig. 3. Note that this is the purpose of SIMD instructions: to have multiple units execute the same instruction with multiple data items. On the other hand, looking at Fig. 1, it can be seen that when multiplexer 21 selects instructions from fetcher 20b, then the

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units 26 in components 24a and 24b will be independently driven (the units in 24a will be driven by a first instruction stream from fetcher 20a while units in 24b will be driven by a second instruction stream from fetcher 20b). Note that this is the purpose of MIMD instructions: to have multiple units execute the multiple instructions with multiple data items.

13. Referring to claim 25, Fernando has taught a processor comprising:

- a) a plurality of arithmetic units. See Fig. 1, components 24 and 26.
- b) a single instruction memory for storing a plurality of series of instructions to be executed by a plurality of arithmetic units. See Fig. 1, components 12 and 26. Fig. 7 shows multiple series of instructions being executed by different units.
- c) an instruction decoder for decoding a series of instructions from said instruction memory, and outputting a decoded result to any of said plurality of arithmetic units. See Fig. 1, component 22a and 22b.
- d) a selector for selectively switching between a plurality of series of instructions from said instruction memory to be decoded by said instruction decoder, and supplying a series of instructions thus selected to said instruction decoder. See Fig. 1, component 21, and claim 44 of Fernando.
- e) wherein said instruction memory has a plurality of ports for issuing said series of instructions to said instruction decoder. See Fig. 1 component 12 and note that multiple ports are connected to multiple fetch units and ultimately to multiple decoders.
- f) wherein said plurality of series of instructions are issued to said plurality of arithmetic units from the instruction memory to be simultaneously and independently driven. Looking at Fig. 1, it can be seen that when multiplexer 21 selects instructions from fetcher 20a, then the units 26 in

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components 24a and 24b will be simultaneously driven (by a first instruction stream). This is shown more specifically in Fig.3. Note that this is the purpose of SIMD instructions: to have multiple units execute the same instruction with multiple data items. On the other hand, looking at Fig. 1, it can be seen that when multiplexer 21 selects instructions from fetcher 20b, then the units 26 in components 24a and 24b will be independently driven (the units in 24a will be driven by a first instruction stream from fetcher 20a while units in 24b will be driven by a second instruction stream from fetcher 20b). Note that this is the purpose of MIMD instructions: to have multiple units execute the multiple instructions with multiple data items.

g) the plurality of arithmetic units execute the single series of instructions concurrently upon the single series of instructions including different commands for each of the plurality of instruction control units. See Fig.4 and note that when the processor is in MIMD mode, a first series of instructions is fetched by unit 20a and sent to arithmetic units 26 in component 24a, and a completely different series of instructions is fetched by unit 20b and sent to arithmetic units 26 in component 24b. See column 3, lines 62-67.

h) the plurality of arithmetic units execute the single series of instructions concurrently upon the single series of instructions including a same command for each of the plurality of instruction control units. See Fig.3 and note that when the processor is in SIMD mode, a single series of instructions is fetched by unit 20a and the series is sent to multiple arithmetic units (components 26 in components 24a and 24b). With SIMD, the instructions are the same. See column 3, lines 47-61, and column 11, line 60, to column 12, line 4.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. Claims 1-3, 5-9, 23, and 28-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fernando et al., U.S. Patent No. 6,272,616, as applied above, in view of Mohamed, U.S. Patent No. 6,366,998.

16. Referring to claim 1, Fernando has taught a processor control apparatus for controlling a plurality of arithmetic units (Fig.4, components 26), said processor control apparatus comprising:

a) a plurality of instruction control units issuing a series of instructions to said plurality of arithmetic units. See Fig.6 and note that multiple units fetch series of instructions and pass them on to arithmetic units.

b) wherein at least one of said instruction control units switches between a first execution process driving said plurality of arithmetic units by a single series of instructions issued from a single one of the plurality of instruction control units and the plurality of arithmetic units execute the single series of instructions concurrently upon the single series of instructions including a same command for each of the plurality of instruction control units. See Fig.3 and note that when the processor is in SIMD mode, a single series of instructions is fetched by unit 20a and the series is sent to multiple arithmetic units (components 26 in components 24a and 24b). With SIMD, the instructions are the same. See column 3, lines 47-61, and column 11, line 60, to column 12, line 4.

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c) a second execution process correspondingly driving said plurality of arithmetic units by a plurality of different series of instructions issued respectively from more than one of said plurality of instruction control units, and in which the processing by the plurality of arithmetic units can be synchronized. See Fig.4 and note that when the processor is in MIMD mode, a first series of instructions is fetched by unit 20a and sent to arithmetic units 26 in component 24a, and a completely different series of instructions is fetched by unit 20b and sent to arithmetic units 26 in component 24b. See column 3, lines 62-67. Furthermore, it should be realized that all arithmetic units are synchronized at least to some degree because everything is based off of clock signals in the system. For instance, looking at Fig.7, it can be seen that multiple data paths (which include arithmetic units) operate in unison over time. Therefore, they are synchronized.

d) Fernando has not taught that the plurality of arithmetic units execute the single series of instructions concurrently upon the single series of instructions including different commands for each of the plurality of instruction control units. However, Mohamed has taught a system in which a fetcher/scheduler may issue either SIMD instructions (same commands) or VLIW instructions (different commands) to groups of arithmetic units. See column 3, lines 51-65, column 4, lines 39-42, and column 5, lines 9-17. A person of ordinary skill in the art would have recognized that since Fernando has taught a system with multiple functional units, Fernando is capable of executing at least SIMD and VLIW instructions. By modifying Fernando to also issue different commands (VLIW) to arithmetic units, the system is able to take advantage of horizontal programming while also minimizing hazards. See column 1, lines 21-25, and 40-41. As a result, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando to allow the fetcher 20a to issue VLIWs with different commands

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to arithmetic units 26, in addition to SIMDs with same commands. One would be motivated to make such a combination because hazards are reduced and horizontal programming is advantageous. In addition, it allows for more flexibility. That is, instead of fetcher 20a only being limited to issuing same commands to units 26, different commands would be issued as well.

17. Referring to claim 2, Fernando in view of Mohamed has taught a processor control apparatus as described in claim 1. Fernando has further taught that said at least one instruction control unit each perform a switching process for switching between said first execution process and said second execution process according to information which is contained in advance in a series of instructions. Note that the multiplexer 21 (Fig.1) is what causes a switch in instruction stream execution. This switch is caused by a change in signal 32i, which is in response to an instruction (CFORK or DFORK) contained in advance in a first instruction stream. See column 5, lines 8-16. Consequently, the system would go from the first process (SIMD/VLIW mode) to the second process (MIMD mode) and vice-versa.

18. Referring to claim 3, Fernando in view of Mohamed has taught a processor control apparatus as described in claim 1. Fernando in view of Mohamed has not explicitly taught that when an M-th one of said instruction control units issues a second series of instructions to an N-th one of said arithmetic units which is performing said second execution process based on a first series of instructions issued by an N-th one of said instruction control units different from said M-th instruction control unit, said M-th instruction control unit is set in a wait state until said N-th arithmetic unit completes said second execution process. However, Official Notice is taken that structural hazards and stalling in response to hazards is well known in the art. More

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specifically, if a functional unit is already executing instructions receiving from a first fetch unit and another fetch unit wants to send new instructions to the same functional unit, then if the previous instructions are still executing, the new instructions must be stalled. As a result, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando in view of Mohamed to stall an Mth control unit that wants to issue instructions to an arithmetic unit that is already executing instructions sent by an Nth control unit.

19. Referring to claim 5, Fernando in view of Mohamed has taught a processor control apparatus as described in claim 1. Fernando has further taught a second storage element which operates to hold, when one of said arithmetic units executing a first series of instructions from one of said instruction control units is switched to execute a second series of instructions from another instruction control unit, data generated by the second series of instructions under execution by associating the data with that instruction control unit which is executing the second series of instructions. See Fig.4, component 25b.

20. Referring to claim 6, Fernando in view of Mohamed has taught a processor control apparatus as described in claim 1. Fernando has further taught that it is determined, based on an instruction executing state of each arithmetic unit, one of said arithmetic units to which a new series of instructions is to be issued by one of said instruction control units, and wherein said one instruction control unit is controlled based on the result of the determination so that the new series of instructions are directed to said one arithmetic unit thus determined. See Fig.7 and note that when it is determined that a particular arithmetic unit executes a fork instruction, a new series is to be sent to another arithmetic unit for execution.

21. Referring to claim 7, Fernando in view of Mohamed has taught a processor control apparatus as described in claim 1. Fernando in view of Mohamed has further taught that each of said series of instructions includes a VLIW type instruction. It should be noted that Fernando and Mohamed teach VLIW, SIMD, and MIMD. All are considered a form of VLIW.

22. Referring to claim 8, Fernando in view of Mohamed has taught a processor control apparatus as described in claim 1. Fernando has further taught that each of said series of instructions includes a series of time-sharing instructions for serially driving a plurality of ones of said arithmetic units. For instance, looking at Fig.7 of Fernando, the series of instructions corresponding to thread 2 execute from time 2 to time 7. Therefore, the thread takes 6 time units to execute and each individual instruction requires some portion of the overall 6 time units for execution. Therefore, each instruction is a time-sharing instruction, i.e., each instruction shares the overall 6 time units with the other instructions.

23. Referring to claim 9, Fernando in view of Mohamed has taught a processor control apparatus as described in claim 1. Fernando has further taught power control elements for controlling power supply to said arithmetic units based on their instruction executing states. See the abstract and column 8, lines 10-12, and note that unused processing elements are deactivated in order to conserve power.

24. Referring to claim 23, Fernando has taught a processor comprising:

a) a plurality of arithmetic units. See Fig.1, components 24a, 24b, and 26.

b) a plurality of instruction control units for issuing a series of instructions to drive said arithmetic units in a controlled manner. See Fig.1 and note a first instruction control unit would

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comprise at least components 20a, 22a, and 12, whereas a second unit would comprise at least components 20b, 22b, and 12. Each of these units issues instructions to the arithmetic units.

c) wherein some of said instruction control units are operable to switch between a first execution process for synchronously driving said plurality of arithmetic units by a single series of instructions upon the instructions including a same command for each of the plurality of instruction control units. See Fig.3 and note that when the processor is in SIMD mode, a single series of instructions is fetched by unit 20a and the series is sent to multiple arithmetic units (components 26 in components 24a and 24b). With SIMD, the instructions are the same. See column 3, lines 47-61, and column 11, line 60, to column 12, line 4.

d) a second execution process independently driving said plurality of arithmetic units by a plurality of different series of instructions, respectively. See Fig.4 and note that when the processor is in MIMD mode, a first series of instructions is fetched by unit 20a and sent to arithmetic units 26 in component 24a, and a completely different series of instructions is fetched by unit 20b and sent to arithmetic units 26 in component 24b. See column 3, lines 62-67.

e) Fernando has not taught synchronously driving the plurality of arithmetic units by a single series of instructions upon the instructions including different commands for each of the plurality of instruction control units. However, Mohamed has taught a system in which a fetcher/scheduler may issue either SIMD instructions (same commands) or VLIW instructions (different commands) to groups of arithmetic units. See column 3, lines 51-65, column 4, lines 39-42, and column 5, lines 9-17. A person of ordinary skill in the art would have recognized that since Fernando has taught a system with multiple functional units, Fernando is capable of executing at least SIMD and VLIW instructions. By modifying Fernando to also issue different

commands (VLIW) to arithmetic units, the system is able to take advantage of horizontal programming while also minimizing hazards. See column 1, lines 21-25, and 40-41. As a result, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando to allow the fetcher 20a to issue VLIWs with different commands to arithmetic units 26, in addition to SIMDs with same commands. One would be motivated to make such a combination because hazards are reduced and horizontal programming is advantageous. In addition, it allows for more flexibility. That is, instead of fetcher 20a only being limited to issuing same commands to units 26, different commands would be issued as well.

25. Referring to claim 28, Fernando has taught a processor controlling method usable with a plurality of instruction control units for controlling a plurality of arithmetic units to execute a plurality of series of instructions, said method comprising:

a) prescribing, in advance in a series of instructions which is to be performed, synchronous execution in which a plurality of predetermined ones of said arithmetic units are synchronously driven by a single series of instructions, or independent execution in which the plurality of predetermined arithmetic units are independently driven by a plurality of respective series of instructions. A single series of instructions may be used to drive a plurality of arithmetic units.

This would occur when the selector 21 shown in Fig.1 selects the instructions from bus 36. This corresponds to Fig.7 at times 10-12 when a single series of instruction (thread 1) is executed by two different data paths (arithmetic units), and hence results in the "combined control" illustrated in the figure. On the other hand, independent execution of a plurality of series of instructions by a plurality of arithmetic units is also shown in Fig.7. For instance, two series (corresponding to

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thread 1 and 2) are independently executed by data paths 1 and 2 (arithmetic units). This would occur when MUX 21 in Fig.1 selects the group of instructions from bus 35.

b) switching between the synchronous driving upon the instructions including a same command for each of the plurality of instruction control units and the independent driving of the predetermined arithmetic units for performing a series of instructions based on the contents of the prescription therein. Clearly from the examples given in Fig.7, synchronous execution of a single series or independent execution of multiple series of instructions is switched back and forth. See Fig.7, and notice data paths 1 and 2 from time 1-12. Again, looking at Fig.1, it can be seen that when multiplexer 21 selects instructions from fetcher 20a, then the units 26 in components 24a and 24b will be simultaneously driven (by a first instruction stream). This is shown more specifically in Fig.3. Note that this is the purpose of SIMD instructions: to have multiple units execute the same instruction with multiple data items. On the other hand, looking at Fig.1, it can be seen that when multiplexer 21 selects instructions from fetcher 20b, then the units 26 in components 24a and 24b will be independently driven (the units in 24a will be driven by a first instruction stream from fetcher 20a while units in 24b will be driven by a second instruction stream from fetcher 20b). Note that this is the purpose of MIMD instructions: to have multiple units execute the multiple instructions with multiple data items.

c) Fernando has not taught synchronous driving upon the instructions including different commands for each of the plurality of instruction control units. However, Mohamed has taught a system in which a fetcher/scheduler may issue either SIMD instructions (same commands) or VLIW instructions (different commands) to groups of arithmetic units. See column 3, lines 51-65, column 4, lines 39-42, and column 5, lines 9-17. A person of ordinary skill in the art would

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have recognized that since Fernando has taught a system with multiple functional units, Fernando is capable of executing at least SIMD and VLIW instructions. By modifying Fernando to also issue different commands (VLIW) to arithmetic units, the system is able to take advantage of horizontal programming while also minimizing hazards. See column 1, lines 21-25, and 40-41. As a result, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando to allow the fetcher 20a to issue VLIWs with different commands to arithmetic units 26, in addition to SIMDs with same commands. One would be motivated to make such a combination because hazards are reduced and horizontal programming is advantageous. In addition, it allows for more flexibility. That is, instead of fetcher 20a only being limited to issuing same commands to units 26, different commands would be issued as well.

26. Referring to claim 29, Fernando has taught a processor control method to control a plurality of arithmetic units connected with a plurality of instruction control units, comprising:

- a) switching between simultaneously driving the plurality of arithmetic units by issuing a single series of instructions from one of the plurality of instruction control units upon the instructions including a same command for each of the plurality of instruction control units and independently driving each of the plurality of arithmetic units by correspondingly issuing series of instructions from the plurality of instruction control units, wherein the switching is performed based on contents of processes to be executed. See Fig. 1, component 21 and note that either a first series of instructions along bus 36 may be selected for decoding or a second series of instructions from bus 35 may be selected for decoding. When the first series of instructions along bus 36 is selected, the system is in SIMD mode (Fig.3), where the plurality of arithmetic

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units (components 26 in component 24b) are driven at the same time as a second group of arithmetic units (components 26 in component 24a) by the same stream of instructions. When the second series of instructions along bus 35 is selected, the system is in MIMD mode (Fig.4), where each of the plurality of arithmetic units (components 26 in component 24b) are driven independently of a second group of arithmetic units (components 26 in component 24a) by different streams of instructions. Also, from Fig.5, it should be noted that the switching between modes is done based on instructions (contents) of the processes. For instance, when a cfork instruction is encountered, SIMD mode is entered where the arithmetic units are simultaneously driven by a single stream whereas when a dfork is encountered, the arithmetic units are independently driven by multiple instruction streams.

b) Fernando has not taught synchronous driving upon the instructions including different commands for each of the plurality of instruction control units. However, Mohamed has taught a system in which a fetcher/scheduler may issue either SIMD instructions (same commands) or VLIW instructions (different commands) to groups of arithmetic units. See column 3, lines 51-65, column 4, lines 39-42, and column 5, lines 9-17. A person of ordinary skill in the art would have recognized that since Fernando has taught a system with multiple functional units, Fernando is capable of executing at least SIMD and VLIW instructions. By modifying Fernando to also issue different commands (VLIW) to arithmetic units, the system is able to take advantage of horizontal programming while also minimizing hazards. See column 1, lines 21-25, and 40-41. As a result, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando to allow the fetcher 20a to issue VLIWs with different commands to arithmetic units 26, in addition to SIMDs with same commands. One would be

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motivated to make such a combination because hazards are reduced and horizontal programming is advantageous. In addition, it allows for more flexibility. That is, instead of fetcher 20a only being limited to issuing same commands to units 26, different commands would be issued as well.

27. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fernando in view of Mohamed, as applied above, and further in view of Parady, U.S. Patent No. 5,933,627 (as applied in the previous Office Action).

28. Referring to claim 4, Fernando in view of Mohamed has taught a processor control apparatus as described in claim 1. Fernando in view of Mohamed has not taught a first storage element for holding a plurality of series of instructions, wherein when an M-th one of said instruction control units issues a second series of instructions to an N-th one of said arithmetic units which is performing said second execution process based on a first series of instructions issued by an N-th one of said instruction control units different from said M-th instruction control unit, said second series of instructions from said M-th instruction control unit are stored in said first storage element, and wherein said N-th arithmetic unit executes instructions which are stored in said first storage element based on information contained in said first series of instructions issued by said N-th instruction control unit. However, Parady has taught such a concept. See Fig.3, for instance, and note the instruction control unit (say 104 in combination with 28), comprises a first storage element to hold thread instructions. If the thread 0 control unit (102 in combination with 28) issues a load that misses the cache or a jump to thread instruction, and the thread 1 control unit is the next to take control, then an Nth arithmetic unit

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will execute the instructions of thread 1 based on information contained in advance in the first series of instructions (i.e., the load or jump). By stalling the instructions in buffers while they're waiting, they are available to the system when they are needed. That is, the processor will not have to make a time-expensive external memory fetch to get the instructions since they reside in buffers. Consequently, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando in view of Mohamed to include the storage element of Parady for holding instructions waiting to be executed based on another series of instructions.

29. Claims 10-12, 14-16, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fernando, as applied above.

30. Referring to claim 10, Fernando has taught a processor control apparatus comprising:

a) a single instruction memory for storing a plurality of series of instructions and supplying them to arithmetic units. See Fig.1, components 12 and 26. Fernando has not taught a plurality of instruction memories for storing a plurality of series of instructions to be executed by a plurality of arithmetic units. However, Official Notice is taken that having a plurality of memories for storing independent series of instructions is well known and accepted in the art. In addition, as shown in Nerwin v. Erlichman, 168 USPQ 177 (1969), to make separable is generally not given patentable weight or would have been an obvious improvement. For instance, a person of ordinary skill in the art would have recognized that by implementing a plurality of memories instead of a single memory with concurrent access capabilities, as taught by Fernando (evident in Fig.7 where multiple streams are fetched at once), then the circuitry required to allow for concurrent access would be eliminated, thereby reducing the complexity and cost of the system.

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Consequently, it would have been obvious to replace Fernando's single instruction memory with a plurality of instruction memories.

b) an instruction decoder for decoding a series of instructions from said instruction memories, and outputting a decoded result to any of said plurality of arithmetic units. See Fig. 1, component 22a, 22b, and 26.

c) and a selector for selectively switching between a plurality of series of instructions from said instruction memories to be decoded by said instruction decoder, and supplying a series of instructions thus selected to said instruction decoder. See Fig. 1, component 21, and claim 44 of Fernando.

d) wherein said plurality of series of instructions are issued to said plurality of arithmetic units from both a single one of the plurality of instruction memories and issued respectively from more than one of said plurality of instruction memories to enable said plurality of arithmetic units to be simultaneously and independently driven. See Fig. 6 and note that instructions are received by multiple units from a single memory (via fetcher 20a) and also, each data path would receive its own series from its own memory and fetcher (20b).

31. Referring to claim 11, Fernando has taught a processor control apparatus as described in claim 10. Fernando has further taught that some of said plurality of series of instructions contain information about selective switching between said series of instructions to be performed by said selector, and wherein said instruction decoder decodes said information contained in a series of instructions, and outputs a switching instruction to said selector. See column 6, lines 41-54, and column 7, lines 17-29, and note that when a CFORK or DFORK is detected by decoder 22a, a

signal 32i (Fig. 1) is generated, which then causes the multiplexer 21 (Fig. 1) to select another series of instructions, which will then be decoded.

32. Referring to claim 12, Fernando has taught a processor control apparatus as described in claim 10. Fernando has further taught that some of said plurality of series of instructions contain a synchronizing instruction for allowing a first predetermined one of said arithmetic units and a second predetermined arithmetic unit to synchronously perform processes, and wherein when said synchronizing instruction is issued to said first predetermined arithmetic unit, said first predetermined arithmetic unit is set in a wait state, and an instruction decoder of said second predetermined arithmetic unit does not output a switching instruction to its associated selector if a process is being executed by said second predetermined arithmetic unit upon issuance of said synchronizing instruction, and does not release the wait state of said first predetermined arithmetic unit until said second predetermined arithmetic unit completes said process. See column 7, lines 52-67. Note that a WAIT instruction will pause the first arithmetic unit until a DJOIN instruction is executed by the second arithmetic unit (synchronization). Furthermore, the stream will not be switched as the second arithmetic unit will continue executing the same thread until it is finished (upon a DJOIN instruction). See Fig. 7.

33. Referring to claim 14, Fernando has taught a processor control apparatus as described in claim 10. Fernando has further taught that each of said series of instructions includes a VLIW type instruction. Note that Fernando has taught SIMD and MIMD instructions. Both are forms of VLIW instructions.

34. Referring to claim 15, Fernando has taught a processor control apparatus as described in claim 10. Fernando has further taught that each of said series of instructions includes a series of

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time-sharing instructions for serially driving a plurality of ones of said arithmetic units. For instance, looking at Fig.7 of Fernando, the series of instructions corresponding to thread 2 execute from time 2 to time 7. Therefore, the thread takes 6 time units to execute and each individual instruction requires some portion of the overall 6 time units for execution. Therefore, each instruction is a time-sharing instruction, i.e., each instruction shares the overall 6 time units with the other instructions.

35. Referring to claim 16, Fernando has taught a processor control apparatus as described in claim 10. Fernando has further taught power control elements for controlling power supply to said arithmetic units based on their instruction executing states. See the abstract and column 8, lines 10-12, and note that unused processing elements are deactivated in order to conserve power.

36. Referring to claim 24, Fernando has taught a processor comprising:

- a) a plurality of arithmetic units. See Fig.1, components 24 and 26.
- b) a single instruction memory for storing a plurality of series of instructions and supplying them to arithmetic units. See Fig.1, components 12. Fernando has not taught a plurality of instruction memories for storing a plurality of series of instructions to be executed by a plurality of arithmetic units. However, Official Notice is taken that having a plurality of memories for storing independent series of instructions is well known and accepted in the art. In addition, as shown in Nerwin v. Erlichman, 168 USPQ 177 (1969), to make separable is generally not given patentable weight or would have been an obvious improvement. For instance, a person of ordinary skill in the art would have recognized that by implementing a plurality of memories instead of a single memory with concurrent access capabilities, as taught by Fernando (evident in

Fig. 7 where multiple streams are fetched at once), then the circuitry required to allow for concurrent access would be eliminated, thereby reducing the complexity and cost of the system. Consequently, it would have been obvious to replace Fernando's single instruction memory with a plurality of instruction memories.

c) an instruction decoder for decoding a series of instructions from said instruction memories, and outputting a decoded result to any of said plurality of arithmetic units. See Fig. 1, component 22a and 22b.

d) and a selector for selectively switching between a plurality of series of instructions from said instruction memories to be decoded by said instruction decoder, and supplying a series of instructions thus selected to said instruction decoder. See Fig. 1, component 21, and claim 44 of Fernando. Note that the MUX can either select a first series of instruction from bus 36 or a second series from bus 35.

e) wherein said plurality of series of instructions are issued to said plurality of arithmetic units from one of the plurality of instruction memories and are issued respectively from said plurality of instruction memories to enable said plurality of arithmetic units to be simultaneously and independently driven. It should be noted that it is inherent that a plurality of series (groups) of instructions are issued to arithmetic units from one of the instruction memories. Clearly, all instructions originate in instruction memory. Furthermore, applicant has used an "or" clause which means the examiner only needs to show the teaching of one of the limitations separated by the "or" clause.

f) the plurality of arithmetic units execute the single series of instructions concurrently upon the single series of instructions including different commands for each of the plurality of instruction

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control units. See Fig.4 and note that when the processor is in MIMD mode, a first series of instructions is fetched by unit 20a and sent to arithmetic units 26 in component 24a, and a completely different series of instructions is fetched by unit 20b and sent to arithmetic units 26 in component 24b. See column 3, lines 62-67.

g) the plurality of arithmetic units execute the single series of instructions concurrently upon the single series of instructions including a same command for each of the plurality of instruction control units. See Fig.3 and note that when the processor is in SIMD mode, a single series of instructions is fetched by unit 20a and the series is sent to multiple arithmetic units (components 26 in components 24a and 24b). With SIMD, the instructions are the same. See column 3, lines 47-61, and column 11, line 60, to column 12, line 4.

37. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fernando, as applied above, in view of Parady, as applied above.

38. Referring to claim 13, Fernando has taught a processor control apparatus as described in claim 10.

a) Fernando has not explicitly taught an instruction queue for temporarily storing, at a stage prior to said selector, a series of instructions to be transmitted from a second one of said instruction memories different from a first one of said instruction memories which stores a series of instructions being executed by said first predetermined arithmetic unit. However, Parady has taught employing multiple instruction queues for holding different series of instructions before one of them is selected. See Fig.3, components 102-108. A person of ordinary skill in the art would have recognized that an instruction queue allows a system to hold a series of instructions

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within the system. Instructions from the queue will be retrieved faster than if they had to be retrieved from main memory since main memory is slower than an on-chip memory, such as Parady's queues. Consequently, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando to include instruction queues on-chip to hold series of instruction so that the instructions are retrieved faster than they would from main memory.

b) and a determiner for determining, based on a series of instructions being executed, whether or not the process being performed by said first predetermined arithmetic unit can be interrupted, said determiner operating to output, if the process can be interrupted, an interrupt signal for interrupting the issuance of the series of instructions to said first instruction memory which is a source of the series of instructions being executed, and generate a switching instruction to said selector to switch to a series of instructions from said instruction queue. Looking at Fig. 1, it should be realized that if the first arithmetic unit 24b is executing a stream of instructions from bus 36 and a DFORK instruction is encountered by decoder 22a, then the MUX for the first arithmetic unit will be configured such that the execution of a first stream of instructions is interrupted in order to execute a second stream of instructions from bus 35. See column 5, lines 17-25, and column 7, lines 17-29. So, in essence, Fernando has taught interrupting a first process in order to execute a second process.

39. Claims 18-22 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fernando in view of Mohamed, as applied above, in view of Dowling, as applied above.

40. Referring to claim 18, Fernando has taught a processor control apparatus for controlling a plurality of arithmetic units (Fig. 1, components 24a and 24b), said processor control apparatus

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comprising a plurality of instruction control units for instructing said arithmetic units to execute a series of instructions, wherein each of said instruction control units includes:

a) an instruction memory for storing a plurality of series of instructions and supplying them to arithmetic units. See Fig.1, components 12 and 26. Fernando has not taught that each instruction control unit includes an instruction memory for storing a plurality of series of instructions, i.e. a plurality of instruction memories. However, Official Notice is taken that having a plurality of memories for storing series of instructions is well known and accepted in the art. In addition, as shown in Nerwin v. Erlichman, 168 USPQ 177 (1969), to make separable is generally not given patentable weight or would have been an obvious improvement. For instance, a person of ordinary skill in the art would have recognized that by implementing a plurality of memories instead of a single memory with concurrent access capabilities, as taught by Fernando (evident in Fig.7 where multiple streams are fetched at once), then the circuitry required to allow for concurrent access would be eliminated, thereby reducing the complexity and cost of the system. Consequently, it would have been obvious to replace Fernando's single instruction memory with a plurality of instruction memories.

b) an instruction decoder for decoding a series of instructions and supplying the decoded series of instructions to an associated one of said arithmetic units. See Fig.1, components 22a and 22b (note that the control units may each comprise at least a decoder, fetch unit, and instruction memory).

c) wherein some of said instruction control units each have an instruction control selector for selectively switching between a first series of instructions from a first instruction memory of one of said instruction control units for simultaneously driving the plurality of arithmetic units upon

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the instructions including a same command for each of the plurality of instruction control units.

See Fig.3 and note that when the processor is in SIMD mode, a single series of instructions is fetched by unit 20a and the series is sent to multiple arithmetic units (components 26 in components 24a and 24b). With SIMD, the instructions are the same. See column 3, lines 47-61, and column 11, line 60, to column 12, line 4.

d) a second series of instructions from a second instruction memory of another instruction control unit different from said one instruction control unit for independently driving each of the plurality of arithmetic units to output one of said first and second series of instructions thus selected to said instruction decoder. See Fig.4 and note that when the processor is in MIMD mode, a first series of instructions is fetched by unit 20a and sent to arithmetic units 26 in component 24a, and a completely different series of instructions is fetched by unit 20b and sent to arithmetic units 26 in component 24b. See column 3, lines 62-67.

e) Fernando has not taught simultaneously driving the plurality of arithmetic units upon the instructions including different commands for each of the plurality of instruction control units. However, Mohamed has taught a system in which a fetcher/scheduler may issue either SIMD instructions (same commands) or VLIW instructions (different commands) to groups of arithmetic units. See column 3, lines 51-65, column 4, lines 39-42, and column 5, lines 9-17. A person of ordinary skill in the art would have recognized that since Fernando has taught a system with multiple functional units, Fernando is capable of executing at least SIMD and VLIW instructions. By modifying Fernando to also issue different commands (VLIW) to arithmetic units, the system is able to take advantage of horizontal programming while also minimizing hazards. See column 1, lines 21-25, and 40-41. As a result, it would have been obvious to one

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of ordinary skill in the art at the time of the invention to modify Fernando to allow the fetcher 20a to issue VLIWs with different commands to arithmetic units 26, in addition to SIMDs with same commands. One would be motivated to make such a combination because hazards are reduced and horizontal programming is advantageous. In addition, it allows for more flexibility. That is, instead of fetcher 20a only being limited to issuing same commands to units 26, different commands would be issued as well.

f) Fernando has further taught that each of said arithmetic units includes a register file (say 25b) for storing data during execution and the ability to access the register file of another arithmetic unit (25a) via bus 38 by using MOVE instructions. See column 6, lines 16-32. Fernando has not taught that each arithmetic unit includes a first register file and a second register file for storing data generated by said first and second series of instructions, respectively, which are supplied from said first and second instruction memories and decoded by an instruction decoder of an associated one of said instruction control units, and an arithmetic unit selector for selectively switching between said data generated by said first and second series of instructions being executed and stored in said first and second register files, respectively, according to an instruction from said associated instruction decoder to supply a selected one of said first and second series of instructions to a calculator.. However, Dowling has taught such a concept. Note from Fig.2, that arithmetic unit 200 includes two register sets 160 and 260 for use in executing two different instruction streams 130 and 230. Based on the stream, one of the register sets is selected by selector 290. By adding a second set of registers to the arithmetic unit, according to column 9, lines 59-62, the processing hardware can quickly switch both internal context and external context, i.e. quickly switch execution from one stream of instructions to

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another, as Fernando has taught. A person of ordinary skill in the art would have also recognized that by having a second register set in an arithmetic unit, the MOVE instruction would not be required to move data from one set to another in order to facilitate execution of another stream.

This would also reduce the complexity of the system. Therefore, in order to speed up the system and reduce complexity, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando such that each arithmetic unit includes a second register set.

41. Referring to claim 19, Fernando in view of Mohamed and further in view of Dowling has taught a processor control apparatus as described in claim 18. Fernando has further taught that each of said series of instructions includes a VLIW type instruction. It should be noted that Fernando and Mohamed teach VLIW, SIMD, and MIMD. All are considered a form of VLIW.

42. Referring to claim 20, Fernando in view of Mohamed and further in view of Dowling has taught a processor control apparatus as described in claim 18. Fernando has further taught that each of said series of instructions includes a series of time-sharing instructions for serially driving a plurality of ones of said arithmetic units. For instance, looking at Fig. 7 of Fernando, the series of instructions corresponding to thread 2 execute from time 2 to time 7. Therefore, the thread takes 6 time units to execute and each individual instruction requires some portion of the overall 6 time units for execution. Therefore, each instruction is a time-sharing instruction, i.e., each instruction shares the overall 6 time units with the other instructions.

43. Referring to claim 21, Fernando in view of Mohamed and further in view of Dowling has taught a processor control apparatus as described in claim 18. Fernando has further taught power control elements for controlling power supply to said arithmetic units based on their instruction

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executing states. See the abstract and column 8, lines 10-12, and note that unused processing elements are deactivated in order to conserve power.

44. Referring to claim 22, Fernando has taught a processor control apparatus for controlling a plurality of arithmetic units (Fig. 1, components 24 and 26), said processor control apparatus comprising a plurality of instruction control units (Fig. 1) for instructing said arithmetic units to execute a series of instructions.

a) wherein said instruction control units have a single instruction memory used in common for storing a plurality of series of instructions (see Fig. 1, component 12), and each comprises an instruction decoder for decoding a series of instructions and supplying the decoded series of instructions to an associated one of said arithmetic units (see Fig. 1, components 22a and 22b, and note that the control units may each comprise at least a decoder, fetch unit, and instruction memory), and said single instruction memory has a plurality of ports for issuing said series of instructions to said respective instruction decoders (See Fig. 1 component 12 and note that multiple ports are connected to multiple fetch units and ultimately to multiple decoders).

b) wherein some of said instruction control units each comprise an instruction control selector for selectively switching between a first series of instructions simultaneously driving the plurality of arithmetic units upon the instructions including a same command for each of the plurality of instruction control units. See Fig. 3 and note that when the processor is in SIMD mode, a single series of instructions is fetched by unit 20a and the series is sent to multiple arithmetic units (components 26 in components 24a and 24b). With SIMD, the instructions are the same. See column 3, lines 47-61, and column 11, line 60, to column 12, line 4.

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c) a second series of instructions independently driving each of the plurality of arithmetic units both from said single instruction memory to output one of said first and second series of instructions thus selected to said instruction decoder. See Fig.4 and note that when the processor is in MIMD mode, a first series of instructions is fetched by unit 20a and sent to arithmetic units 26 in component 24a, and a completely different series of instructions is fetched by unit 20b and sent to arithmetic units 26 in component 24b. See column 3, lines 62-67.

d) Fernando has not taught simultaneously driving the plurality of arithmetic units upon the instructions including different commands for each of the plurality of instruction control units. However, Mohamed has taught a system in which a fetcher/scheduler may issue either SIMD instructions (same commands) or VLIW instructions (different commands) to groups of arithmetic units. See column 3, lines 51-65, column 4, lines 39-42, and column 5, lines 9-17. A person of ordinary skill in the art would have recognized that since Fernando has taught a system with multiple functional units, Fernando is capable of executing at least SIMD and VLIW instructions. By modifying Fernando to also issue different commands (VLIW) to arithmetic units, the system is able to take advantage of horizontal programming while also minimizing hazards. See column 1, lines 21-25, and 40-41. As a result, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando to allow the fetcher 20a to issue VLIWs with different commands to arithmetic units 26, in addition to SIMDs with same commands. One would be motivated to make such a combination because hazards are reduced and horizontal programming is advantageous. In addition, it allows for more flexibility. That is, instead of fetcher 20a only being limited to issuing same commands to units 26, different commands would be issued as well.

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e) Fernando has further taught wherein each of said arithmetic units includes a register file (say 25b) for storing data during execution and the ability to access the register file of another arithmetic unit (25a) via bus 38 by using MOVE instructions. See column 6, lines 16-32. Fernando has not taught that each arithmetic unit includes a first register file and a second register file for storing data generated by said first and second series of instructions, respectively, which are supplied from said first and second instruction memories and decoded by an instruction decoder of an associated one of said instruction control units, and an arithmetic unit selector for selectively switching between said data generated by said first and second series of instructions being executed and stored in said first and second register files, respectively, according to an instruction from said associated instruction decoder to supply a selected one of said first and second series of instructions to a calculator.. However, Dowling has taught such a concept. Note from Fig.2, that arithmetic unit 200 includes two register sets 160 and 260 for use in executing two different instruction streams 130 and 230. Based on the stream, one of the register sets is selected by selector 290. By adding a second set of registers to the arithmetic unit, according to column 9, lines 59-62, the processing hardware can quickly switch both internal context and external context, i.e. quickly switch execution from one stream of instructions to another, as Fernando has taught. A person of ordinary skill in the art would have also recognized that by having a second register set in an arithmetic unit, the MOVE instruction would not be required to move data from one set to another in order to facilitate execution of another stream. This would also reduce the complexity of the system. Therefore, in order to speed up the system and reduce complexity, it would have been obvious to one of ordinary skill

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in the art at the time of the invention to modify Fernando such that each arithmetic unit includes a second register set.

45. Referring to claim 26, Fernando has taught a processor comprising:

- a) a plurality of arithmetic units (Fig.1, components 24 and 26).
- b) a plurality of instruction control units (Fig.1) for driving said arithmetic units in a controlled manner, wherein each of said instruction control units includes:
 - c) a single instruction memory for storing a plurality of series of instructions and supplying them to arithmetic units. See Fig.1, components 12 and 26. Fernando has not taught that each instruction control unit includes an instruction memory for storing a plurality of series of instructions, i.e. a plurality of instruction memories. However, Official Notice is taken that having a plurality of memories for storing series of instructions is well known and accepted in the art. In addition, as shown in Nerwin v. Erlichman, 168 USPQ 177 (1969), to make separable is generally not given patentable weight or would have been an obvious improvement. For instance, a person of ordinary skill in the art would have recognized that by implementing a plurality of memories instead of a single memory with concurrent access capabilities, as taught by Fernando (evident in Fig.7 where multiple streams are fetched at once), then the circuitry required to allow for concurrent access would be eliminated, thereby reducing the complexity and cost of the system. Consequently, it would have been obvious to replace Fernando's single instruction memory with a plurality of instruction memories.
- d) an instruction decoder for decoding a series of instructions and supplying the decoded series of instructions to an associated one of said arithmetic units. See Fig.1, components 22a and 22b

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(note that the control units may each comprise at least a decoder, fetch unit, and instruction memory).

e) wherein some of said instruction control units each have an instruction control selector for selectively switching between a first series of instructions from a first instruction memory of one of said instruction control units simultaneously driving the plurality of arithmetic units and a second series of instructions from a second instruction memory of another instruction control unit different from said one instruction control unit independently driving each of the plurality of arithmetic units to output one of said first and second series of instructions thus selected to said instruction decoder, based on contents of processes to be executed. See Fig. 1, component 21 and note that either a first series of instructions along bus 36 may be selected for decoding or a second series of instructions from bus 35 may be selected for decoding. When the first series of instructions along bus 36 is selected, the system is in SIMD mode (Fig.3), where the plurality of arithmetic units (components 26 in component 24b) are driven at the same time as a second group of arithmetic units (components 26 in component 24a) by the same stream of instructions. When the second series of instructions along bus 35 is selected, the system is in SIMD mode (Fig.4), where each of the plurality of arithmetic units (components 26 in component 24b) are driven independently of a second group of arithmetic units (components 26 in component 24a) by different streams of instructions. Also, from Fig.5, it should be noted that the switching between modes is done based on instructions (contents) of the processes. For instance, when a cfork instruction is encountered, SIMD mode is entered where the arithmetic units are simultaneously driven by a single stream whereas when a dfork is encountered, the arithmetic units are independently driven by multiple instruction streams.

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f) wherein each of said arithmetic units includes a register file (say 25b) for storing data during execution and the ability to access the register file of another arithmetic unit (25a) via bus 38 by using MOVE instructions. See column 6, lines 16-32. Fernando has not taught that each arithmetic unit includes a first register file and a second register file for storing data generated by said first and second series of instructions, respectively, which are supplied from said first and second instruction memories and decoded by an instruction decoder of an associated one of said instruction control units, and an arithmetic unit selector for selectively switching between said data generated by said first and second series of instructions being executed and stored in said first and second register files, respectively, according to an instruction from said associated instruction decoder to supply a selected one of said first and second series of instructions to a calculator.. However, Dowling has taught such a concept. Note from Fig.2, that arithmetic unit 200 includes two register sets 160 and 260 for use in executing two different instruction streams 130 and 230. Based on the stream, one of the register sets is selected by selector 290. By adding a second set of registers to the arithmetic unit, according to column 9, lines 59-62, the processing hardware can quickly switch both internal context and external context, i.e. quickly switch execution from one stream of instructions to another, as Fernando has taught. A person of ordinary skill in the art would have also recognized that by having a second register set in an arithmetic unit, the MOVE instruction would not be required to move data from one set to another in order to facilitate execution of another stream. This would also reduce the complexity of the system. Therefore, in order to speed up the system and reduce complexity, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando such that each arithmetic unit includes a second register set.

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g) the plurality of arithmetic units execute the single series of instructions concurrently upon the single series of instructions including different commands for each of the plurality of instruction control units. See Fig.4 and note that when the processor is in MIMD mode, a first series of instructions is fetched by unit 20a and sent to arithmetic units 26 in component 24a, and a completely different series of instructions is fetched by unit 20b and sent to arithmetic units 26 in component 24b. See column 3, lines 62-67.

h) the plurality of arithmetic units execute the single series of instructions concurrently upon the single series of instructions including a same command for each of the plurality of instruction control units. See Fig.3 and note that when the processor is in SIMD mode, a single series of instructions is fetched by unit 20a and the series is sent to multiple arithmetic units (components 26 in components 24a and 24b). With SIMD, the instructions are the same. See column 3, lines 47-61, and column 11, line 60, to column 12, line 4.

46. Referring to claim 27, Fernando has taught a processor comprising:

- a) a plurality of arithmetic units (Fig.1, components 24 and 26).
- b) a plurality of instruction control units (Fig.1) for driving said arithmetic units in a controlled manner.
- c) wherein said instruction control units have a single instruction memory used in common for storing a plurality of series of instructions (see Fig.1, component 12), and each includes an instruction decoder for decoding a series of instructions and supplying the decoded series of instructions to an associated one of said arithmetic units (see Fig.1, components 22a and 22b, and note that the control units may each comprise at least a decoder, fetch unit, and instruction memory), and said single instruction memory has a plurality of ports for issuing said series of

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instructions to said respective instruction decoders (See Fig.1 component 12 and note that multiple ports are connected to multiple fetch units and ultimately to multiple decoders).

d) wherein some of said instruction control units each have an instruction control selector for selectively switching between a first series of instructions simultaneously driving the plurality of arithmetic units upon the instructions including a same command for each of the plurality of instruction control units. See Fig.3 and note that when the processor is in SIMD mode, a single series of instructions is fetched by unit 20a and the series is sent to multiple arithmetic units (components 26 in components 24a and 24b). With SIMD, the instructions are the same. See column 3, lines 47-61, and column 11, line 60, to column 12, line 4.

d) a second series of instructions independently driving each of the plurality of arithmetic units both from said single instruction memory to output one of said first and second series of instructions thus selected to said instruction decoder, based on contents of processes to be executed. See Fig.4 and note that when the processor is in MIMD mode, a first series of instructions is fetched by unit 20a and sent to arithmetic units 26 in component 24a, and a completely different series of instructions is fetched by unit 20b and sent to arithmetic units 26 in component 24b. See column 3, lines 62-67.

e) Fernando has not taught simultaneously driving the plurality of arithmetic units upon the instructions including different commands for each of the plurality of instruction control units. However, Mohamed has taught a system in which a fetcher/scheduler may issue either SIMD instructions (same commands) or VLIW instructions (different commands) to groups of arithmetic units. See column 3, lines 51-65, column 4, lines 39-42, and column 5, lines 9-17. A person of ordinary skill in the art would have recognized that since Fernando has taught a system

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with multiple functional units, Fernando is capable of executing at least SIMD and VLIW instructions. By modifying Fernando to also issue different commands (VLIW) to arithmetic units, the system is able to take advantage of horizontal programming while also minimizing hazards. See column 1, lines 21-25, and 40-41. As a result, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando to allow the fetcher 20a to issue VLIWs with different commands to arithmetic units 26, in addition to SIMDs with same commands. One would be motivated to make such a combination because hazards are reduced and horizontal programming is advantageous. In addition, it allows for more flexibility. That is, instead of fetcher 20a only being limited to issuing same commands to units 26, different commands would be issued as well.

f) wherein each of said arithmetic units includes a register file (say 25b) for storing data during execution and the ability to access the register file of another arithmetic unit (25a) via bus 38 by using MOVE instructions. See column 6, lines 16-32. Fernando has not taught that each arithmetic unit includes a first register file and a second register file for storing data generated by said first and second series of instructions, respectively, which are supplied from said first and second instruction memories and decoded by an instruction decoder of an associated one of said instruction control units, and an arithmetic unit selector for selectively switching between said data generated by said first and second series of instructions being executed and stored in said first and second register files, respectively, according to an instruction from said associated instruction decoder to supply a selected one of said first and second series of instructions to a calculator.. However, Dowling has taught such a concept. Note from Fig.2, that arithmetic unit 200 includes two register sets 160 and 260 for use in executing two different instruction streams

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130 and 230. Based on the stream, one of the register sets is selected by selector 290. By adding a second set of registers to the arithmetic unit, according to column 9, lines 59-62, the processing hardware can quickly switch both internal context and external context, i.e. quickly switch execution from one stream of instructions to another, as Fernando has taught. A person of ordinary skill in the art would have also recognized that by having a second register set in an arithmetic unit, the MOVE instruction would not be required to move data from one set to another in order to facilitate execution of another stream. This would also reduce the complexity of the system. Therefore, in order to speed up the system and reduce complexity, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Fernando such that each arithmetic unit includes a second register set.

Conclusion

47. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

48. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Applicant is reminded that in amending in response to a rejection of claims, the patentable novelty must be clearly shown in view of the state of the art disclosed by the references cited and the objections made. Applicant must also show how the amendments avoid such references and objections. See 37 CFR § 1.111(c).

Kogge, U.S. Patent No. 5,475,856, has taught a dynamic multi-mode parallel processing array in which SIMD and MIMD modes are implemented. Multiple control units are coupled to a single memory for receiving a single stream of instructions and also to independent memories for receiving independent streams of instruction.

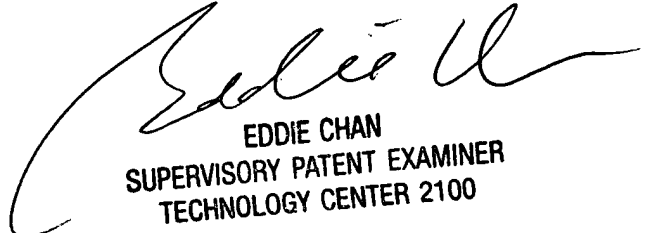
Any inquiry concerning this communication or earlier communications from the examiner should be directed to David J. Huisman whose telephone number is (571) 272-4168. The examiner can normally be reached on Monday-Friday (8:00-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on (571) 272-4162. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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DJH
David J. Huisman
November 2, 2005



EDDIE CHAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100